



# SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT I, TAKURO SEKIYA, a citizen of Japan residing at No.23-38, Mitakedai, Midori-Ku, Yokohama-Shi, Kanagawa-Ken, Japan have invented certain new and useful improvements in

INKJET RECORDING HEAD ADAPTED FOR  
IMPROVED PRECISION OF MOUNTING

of which the following is a specification :



BACKGROUND OF THE INVENTION

*Doc 1*  
The present invention generally relates to inkjet printers and more particularly to a recording head of such an inkjet printer.

5           Inkjet printers are used extensively for printers of personal computers and other information processing apparatuses.

          Conventional inkjet printers have a recording head for ejecting ink toward a recording object in the form of inkjet and an ink reservoir for holding the ink, wherein the ink reservoir is formed separate from the recording head and the ink is supplied to the recording head from the reservoir via an interconnection tube. Such a construction of the inkjet printer is disclosed for example in the Japanese Laid-open Patent Publication 10 57-24283. On the other hand, such a construction of the conventional inkjet recording apparatus to use the interconnection tube is complex and increases the size of the recording apparatus. Further, such a construction requires a substantial workload of the user of the printer when replacing the ink reservoir.

          On the other hand, another type of inkjet recording apparatus is disclosed in the Japanese Laid-open Patent Publications 3-101954 - 3-101972, wherein the recording head is fixed upon the ink reservoir.

1     Thereby, the recording head and the ink reservoir form  
an integral cartridge. By constructing the inkjet  
recording apparatus as such, one can eliminate the  
interconnection tube between the head and the ink  
5     reservoir and the construction of the printer apparatus  
is substantially simplified. Further, the overall size  
of the recording apparatus is reduced.

      In the latter integral type inkjet recording  
apparatus, the integral cartridge is replaced by a new  
10    one when the ink in the ink reservoir is used up. As  
the recording head is much more expensive as compared  
with the ink reservoir, such a construction of the  
integral cartridge has a drawback of high running cost  
although the workload of the user to replace the ink  
15    reservoir is substantially reduced.

#### SUMMARY OF THE INVENTION

      Accordingly, it is a general object of the  
present invention to provide a novel and useful  
20    recording head unit of an inkjet recording apparatus  
wherein the foregoing problems are eliminated.

      Another and more specific object of the  
present invention is to provide a recording head unit of  
an inkjet recording apparatus, comprising a recording  
25    head part for recording an image on a recording object

1 by forming a jet of ink and an ink reservoir part for  
containing the ink wherein the ink reservoir part alone  
is replaced when the ink contained therein is used up  
with a simple working procedure of the user.

5 Another object of the present invention is to  
provide a recording head of an inkjet recording  
apparatus for recording an image on an object,  
comprising:

a recording head unit supplied with ink for  
10 recording an image on a recording object by forming a  
jet of the ink, said recording head unit comprising: a  
nozzle for ejecting said jet; a passage of ink provided  
in communication with said ink nozzle for supplying said  
ink to said nozzle; an energization part provided on  
15 said passage for applying energy to said ink in said  
passage to form said jet; and an ink inlet formed in  
communication with said passage for receiving said ink,  
said inlet including therein filter means which is made  
from stainless steel mesh for eliminating particles from  
20 said ink supplied to said inlet; and

an ink reservoir unit for holding therein said  
ink, said ink reservoir supplying said ink held therein  
to said inlet of said recording head part, said ink  
reservoir accommodating therein a material infiltrated  
25 with said ink;

- 1           said recording head unit carrying thereon  
first connection means as a part of said recording head  
unit, for connecting said recording head unit to said  
ink reservoir unit;
- 5           said ink reservoir unit carrying thereon  
second connection means corresponding to said first  
connection means as a part of said ink reservoir unit,  
for connecting said ink reservoir unit to said recording  
head unit;
- 10          said first and second connection means being  
so formed that said first and second connection means  
establish, when said ink reservoir unit is mounted upon  
said recording head unit, a detachable engagement with  
each other in a manner, such that said ink in said  
15          reservoir unit flows to said passage in said recording  
head unit.

          According to the present invention, one can  
eliminate the complex interconnection tube between the  
ink reservoir and the recording head while allowing  
20          continuous use of expensive recording head unit when the  
ink held in the ink reservoir unit is used up. By  
holding the ink in the state infiltrated in a medium,  
one can avoid the formation of bubbles in the ink  
reservoir unit even when the recording head is shaken  
25          violently.

1           In a preferred embodiment of the present  
invention, said recording head further includes a  
carriage member adapted to be mounted upon an image  
recording apparatus for carrying said recording head  
5   unit and said reservoir unit together in the state that  
said recording head unit and said reservoir unit are  
connected with each other, said carriage member having a  
positioning part for determining the position of said  
nozzle of said recording head unit with respect to said  
10   carriage member. By providing the carriage member, one  
can maintain an exact alignment of the recording head  
unit with respect to the recording apparatus and hence  
to a recording object such as a recording sheet before  
and after the replacement of the ink reservoir.

15           In another preferred embodiment of the present  
invention, said carriage member includes a base part for  
carrying said recording head unit and said ink reservoir  
unit and a cover part mounted upon said base part in a  
manner rotatable with respect thereto, said positioning  
20   part being provided on said base part in the form of a  
cutout adapted to the shape of said recording head unit  
for holding said recording head unit therein, said cover  
part urging said recording head unit resiliently upon  
said base part.

25           In another preferred embodiment of the present

1 invention, said cover part carries thereon an  
interconnection pattern for carrying electric signals,  
said recording head unit thereby establishing an  
electrical contact with said interconnection pattern  
5 when said recording head unit and said ink reservoir  
unit are mounted upon said carriage member.

In another preferred embodiment of the present  
invention, said recording head unit has a first guide  
part for guiding said ink reservoir unit with respect to  
10 said recording head unit along a path for mounting and  
dismounting said ink reservoir unit on and from said  
recording head unit, said ink reservoir unit having a  
corresponding second guide part for engagement with said  
first guide part.

15 In another preferred embodiment of the present  
invention, said recording head unit has a generally L-  
shaped form having a front part and a top part connected  
with each other, said ink reservoir unit having a  
rectangular shape having a front surface for engagement  
20 with said front part of said recording head unit and a  
top surface for engagement with said top part of said  
recording head unit, said recording head unit carrying  
said first guide part at a lower surface of said top  
part while said reservoir part carrying said second  
25 guide part at said top surface.

1           In another preferred embodiment of the present  
invention, said second connection means of said ink  
reservoir unit comprises an opening and a seal membrane  
sealing said opening, said first connection means of  
5   said recording head unit being provided so as to break  
said seal membrane when said ink reservoir unit is  
mounted upon said recording head unit.

          In another preferred embodiment of the present  
invention, said first connection means of said recording  
10   head unit comprises a substantially rigid tubular member  
for insertion into said ink reservoir part such that  
said tubular member breaks said seal membrane when said  
ink reservoir unit is mounted upon said recording head  
part, said tubular member having a passage of ink  
15   therein in communication with said passage of ink in  
said recording head unit.

          In another preferred embodiment of the present  
invention, said tubular member has a sharp pointed part  
that breaks said seal membrane when said ink reservoir  
20   unit is mounted upon said recording head unit.

          In another preferred embodiment of the present  
invention, said ink reservoir unit further has a vent  
for communicating an interior and an exterior of said  
ink reservoir unit, said vent being closed by a  
25   removable seal member.

1           In another preferred embodiment of the present invention, said removable seal member comprises a screw threaded into a wall of said ink reservoir unit.

          In another preferred embodiment of the present invention, said removable seal member comprises a  
5           substantially rigid projection formed unitarily to a wall of said ink reservoir unit in correspondence to said vent for closing said vent, said projection being so shaped that said vent is formed upon breaking of said  
10          projection.

          Other objects and further features of the present invention will become apparent from the following detailed description when read in conjunction with the attached drawings.

15

BRIEF DESCRIPTION OF THE DRAWINGS

          FIG.1 is a diagram showing a recording head unit according to a first embodiment of the present invention in a perspective view;

20           FIG.2 is a diagram showing the recording head unit of FIG.1 in a cross sectional view;

          FIG.3 is a diagram showing the recording head unit of FIG.1 in an exploded view;

          FIG.4 is a diagram showing a head chip used in  
25          the recording head unit of FIG.1 in a perspective view;

1           FIG.5 is a diagram showing the head chip of  
FIG.4 in an exploded view;

          FIG.6 is a diagram showing a part of the head  
chip of FIG.4 in an enlarged cross sectional view;

5           FIG.7 is a diagram showing the connection of  
an ink reservoir to a recording head part in the  
recording head unit of FIG.1;

          FIG.8 is a diagram showing a part of the ink  
reservoir used in the recording head unit of FIG.1 in an  
10 enlarged cross sectional view;

          FIG.9 is a diagram showing the construction of  
a carriage used in an inkjet printer for holding the  
recording head unit of FIG.1 with a proper positional  
alignment;

15          FIG.10 is a diagram showing the state wherein  
the recording head unit is held on the carriage of FIG.9  
in a cross sectional view;

          FIG.11 is a diagram showing a second  
embodiment of the present invention in the state before  
20 the ink reservoir is mounted upon the recording head  
part in an enlarged cross sectional view;

          FIG.12 is a diagram similar to FIG.11 showing  
the second embodiment in the state wherein the ink  
reservoir is mounted upon the recording head part; and

25          FIGS.13(A) and 13(B) are diagrams showing a

1 third embodiment of the present invention in a cross  
sectional view.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

5 FIG.1 shows a recording head 100 according to  
a first embodiment of the present invention in a  
perspective view, while FIG.2 shows an elevational cross  
sectional view of the recording head 100 of FIG.1.  
Further, FIG.3 is an exploded view of the recording head  
10 100 of FIG.1.

Referring to FIG.1, the recording head 100 is  
generally formed of a recording head unit (1) and an ink  
reservoir unit 2, wherein the recording head unit 1  
includes a base part 3 that carries thereon a flexible  
15 printed circuit board (FPCB) 4 and a head chip 5.

FIGS.4 and 5 show the head chip 5. Referring  
to FIGS.4 and 5, the head chip 5 is generally formed of  
a substrate 6 and an orifice plate 7. The substrate 6  
carries thereon a number of energization parts 8 formed  
20 by well known photolithographic processes, wherein, as  
shown in FIG.5, the energization part 8 includes a  
number of resistance patterns (9) acting as a heater, and  
each resistance pattern 9 is connected to a control  
electrode 10 for receiving a driving signal and a common  
25 electrode 11 connected to the ground.

1           FIG.6 shows the cross sectional view of the  
head chip 5, wherein it will be noted that the substrate  
6, typically formed of silicon, is covered with a  
silicon oxide film 12 having a thickness of 1 - 2  $\mu\text{m}$ ,  
5           and the silicon oxide film 12 carries thereon a  
resistance layer 13 of  $\text{HfB}_2$  with a thickness of about  
3000 Å. Typically, the layer 13 is formed by a  
sputtering process. The resistance layer 13 is  
patterned according to the desired shape of a resistance  
10          heater 9 by a known photolithographic process, and a  
layer of Al or Al alloy is deposited on the resistance  
heater 9 with a thickness of about 1  $\mu\text{m}$  by a sputtering  
process. The Al layer thus deposited is patterned  
subsequently by a photolithographic process to form the  
15          electrodes 10 and 11. Further, the resistance heater 9  
and the electrodes 10 and 11 thus formed are covered by  
a protective silicon oxide film 14 deposited by a  
sputtering process with a thickness of about 1  $\mu\text{m}$ , and  
another protective film 15 of Ta is deposited on the  
20          silicon oxide layer 14 in correspondence to where the  
resistance heater 9 is formed.

          In the foregoing structure of FIG.6, it should  
be noted that the silicon oxide film 12 is provided for  
dissipating heat generated by the resistance heater 9 to  
25          the substrate 6 efficiently, while the silicon oxide

1 film 14 is provided to protect the resistance heater 9  
or the electrodes 10 and 11 from the corrosion by the  
ink. On the other hand, the Ta film 15 protects the  
resistance heater 9 from mechanical shock that is caused  
5 in response to the formation of cavitation in the ink.  
It should be noted that such a shock is caused when the  
bubbles, formed on the resistance heater 9 as a result  
of the heating, collapse.

On the substrate 6 thus formed, there is  
10 provided an ink barrier structure 17, which defines a  
passage 16 of ink for guiding the ink to the resistance  
heater 9, with a thickness of 20 - 50  $\mu\text{m}$ . Typically, a  
dry film photoresist is used for the material of the ink  
barrier structure 17, and the passage 16 is formed with  
15 a desired shape as a result of photolithographic  
patterning process. Further, the substrate 6 is formed  
with an opening 18 for introducing the ink into the  
passage 16 as indicated in FIG.5, wherein the opening 18  
penetrates through the substrate 6 from the lower major  
20 surface to the upper major surface. Such an opening 18  
may be formed by a laser beam cutting or machining  
process.

FIG.6 further shows the construction of the  
orifice plate 7 in the cross sectional view.

25 Referring to FIG.6, the orifice plate 7 is

1 provided on the ink barrier structure 17 and may be made  
of a nickel plate formed by an electro-forming process  
with a thickness of 50 - 150  $\mu\text{m}$ , wherein the orifice  
place 7 thus formed is subsequently subjected to a gold  
5 plating process. The orifice plate 7 is provided with a  
number of nozzles 20 facing the resistance heater 9,  
wherein each nozzle 20 may have a diameter of 30 - 50  
 $\mu\text{m}$  depending upon the specification of the inkjet  
recording apparatus. As indicated in FIGS.4 and 5, the  
10 nozzle 20 is arranged on the orifice plate 7 in two rows  
in correspondence to two rows of the resistance heaters  
9.

When assembling the head chip 5, the orifice  
plate 7 is urged firmly upon the ink barrier structure  
15 17 while applying heat to the structure 17. Thereby,  
the sticky dry film photoresist of the ink barrier  
structure 17 holds the orifice plate 7 firmly thereon.

The head chip 5 thus formed as shown in FIG.4  
is then mounted upon the base part 3 as indicated in  
20 FIGS.1 - 3, and the FPCB 4 is attached upon the base  
part 3 in electrical connection to the head chip 5 as  
shown in FIG.1 by a wire bonding process. It should be  
noted that the FPCB 4 carries thereon a number of  
contact pads 21 for electrical connection to the  
25 external apparatus for receiving image signals.

1           Next, the ink reservoir unit 2 will be  
described with reference to FIGS.2 and 3.

Referring to the drawings, the ink reservoir  
unit 2 forms a case that accommodates therein a  
5   deformable porous material 22 infiltrated with ink such  
as a sponge. The ink reservoir unit 2 is formed so as  
to be mounted detachably upon the base part 3 and hence  
to the recording head unit 1 to form the unitary  
recording head 100, wherein the base part 3 is provided  
10   with an ink chamber 19 immediately behind the substrate  
6 of the head chip 5 in communication with the opening  
18 in the substrate 6. Further, the ink reservoir unit  
2 is mounted upon the base part 3 of the recording head  
unit 1 such that the reservoir 2 is located immediately  
15   behind the ink chamber 19.

The base part 3 is formed with a rigid tubular  
member 27 as an integral part of the base part 3 such  
that the tubular member 27 projects in the outward  
direction as indicated in FIG.7, wherein the tubular  
20   member 27 is formed with a passage 28 of ink in  
communication with the ink chamber 19 for receiving the  
ink from the ink reservoir unit 2. The ink reservoir  
unit 2 in turn is provided with a corresponding orifice  
25   25 for accepting the tubular member 27 when the  
reservoir unit 2 is mounted upon the recording head unit

1 1, and an elastic seal ring 26 is provided on the  
orifice 25. The seal ring 26 has a through hole 26a  
therein, and the tubular member 27 is inserted into the  
reservoir 2 through the inner hole 26a of the ring 26 as  
5 indicated in FIG.7 when the ink reservoir unit 2 is  
mounted upon the recording head unit 1. The elastic  
seal ring 26 thereby provides an effective seal between  
the recording head unit 1 and the reservoir 2 for  
preventing the leak of the ink flowing from the ink  
10 reservoir unit 2 to the recording head unit 1.

In the state of FIG.7, the ink held in the  
reservoir 2 is supplied to the ink chamber 19 of the  
recording head unit 1 via the passage 28 in the tubular  
member 27. In order to achieve a reliable sealing  
15 action, the diameter of the inner hole 26a of the ring  
26 is formed smaller than the outer diameter of the  
tubular member 27 by about 10 - 20 %. Further, there is  
provided a filter 29 which is made from stainless steel  
mesh for eliminating particles or dusts from entering  
20 into the ink chamber 19 of the base part 3 with the flow  
of the ink.

In order to mount the ink reservoir unit 2  
properly upon the base part 3 of the recording head unit  
1 to form the recording head 100, the ink reservoir unit  
25 2 is provided with a guide part 23 that projects upward

1 on the top surface of the unit 2 as indicated in the  
exploded view of FIG.3. In FIG.3, it will be further  
noted that the base part 3 has a front plate and a top  
plate for fitting the front and top surfaces of the  
5 reservoir 2 respectively, and a depression (24) is  
provided on the lower surface of the base part 3 in  
correspondence to the projection 23 as a corresponding  
guide part as indicated in FIG.2. The guide part 23  
forms a guide rail extending from the front surface  
10 toward the rear surface on the top surface of the ink  
reservoir unit 2, and a corresponding guide groove  
forming the guide part 24 extends in the forward  
direction from the rear edge of the top plate of the  
base part 3.

15 When assembling the ink reservoir unit 2 and  
the recording head unit 1 together, the ink reservoir  
unit 2 is attached to the base part 3 such that the  
front edge of the guide part 23 is accepted by the rear  
edge of the guide part 24. Under this state, the ink  
20 reservoir unit 2 is pushed forward with respect to the  
base part 3 until the tubular member 27 is fully  
inserted into the reservoir 2 via the inner hole 26a of  
the elastic ring 26. It should be noted that the ink  
reservoir unit 2 thus mounted upon the base part 3 of  
25 the recording head unit 1 is detachable therefrom by

1 simply pulling it out in the backward direction. Thus,  
the user of the inkjet printer can replace the ink  
reservoir unit 2 by simply removing an old ink reservoir  
unit from the base part 3 and replacing with a new one.  
5 It should be noted that the tubular member 27 has a  
sufficient rigidity that allows insertion into the ink  
reservoir unit 2 against the resistance exerted by the  
elastic ring 26.

In the state that the ink reservoir unit 2 is  
10 supplied from a vendor, the orifice 25 is sealed by  
applying a suitable seal means (not shown in FIG.7) on  
the elastic ring 26. This seal is broken when the  
reservoir 2 is mounted upon the base part 3. Because of  
the rigidity of the tubular member 27, the breaking of  
15 the seal is achieved without <sup>a</sup> problem.

*a*  
As indicated in FIGS.2 and 3 or in FIG.7, the  
ink reservoir unit 2 accommodates therein a flexible  
porous material such as a sponge 22 infiltrated with  
ink, and a rear cover lid 30 closes the rear opening of  
20 the ink reservoir unit 2. The cover lid 30 is provided  
with a minute vent 30a for communicating the interior of  
the reservoir unit 2 with the surrounding atmosphere for  
compensating for the drop of pressure that occurs with  
the consumption of the ink in the ink reservoir unit 2,  
25 wherein the vent 30a is plugged with a screw member 31

1 or other suitable seal means as indicated in FIG.8 in  
the state that the unit 2 is supplied from the vendor.  
When using the unit 2 in an inkjet printer, the user  
removes the screw member 31.

5 Next, a carriage 32 for carrying the recording  
head 100 thus formed in an inkjet recording apparatus  
will be described with reference to FIGS.9 and 10.

Referring to FIG.9, the carriage 32 is  
provided in an inkjet image recording apparatus  
10 schematically illustrated by a reference numeral 150,  
wherein the carriage 32 is held on the recording  
apparatus 150 in a manner movable in the horizontal  
scanning direction as indicated by an arrow. As usual  
in the inkjet printers, there is provided a platen  
15 roller 151 for holding a recording sheet thereon, and  
the recording head 100 carried on the carriage 32  
records an image on the recording sheet on the platen  
roller 151 in the form of dot pattern formed by the  
inkjet as the head 100 is moved back and forth in the  
20 horizontal scanning direction.

The carriage 32 includes an L-shaped base  
section 33 and an L-shaped cover member 35 held  
rotatably upon the lower base section 33 at a hinge 34.  
The L-shaped base section 33 has a front member 36a on  
25 which a cutout 36 is formed for holding the base part 3

1 of the recording head unit 1, wherein the cutout 36  
includes two mutually opposing side edges 36b and a  
bottom edge 36c both formed on the foregoing front  
member 36a. In the state of FIG.9, the front surface 3a  
5 of the ink reservoir unit 2 (see FIG.1) contacts with  
the front member 36a of the L-shaped base section 33.

The cutout 36 holds therein the front  
projecting part of the base part 3 that carries thereon  
the head chip 5 and the ink chamber 19 as indicated in  
10 FIG.10. In correspondence to the construction of  
FIG.10, it will be noted that the cutout 36 has a shape  
corresponding to the shape of the projecting part of the  
base part 3 such that the bottom surface 3c of the  
projecting part (FIG.1) is supported by the bottom edge  
15 36c and both lateral sides 3b (FIG.1) of the projecting  
part is supported laterally by the side edges 36b.

The L-shaped cover member 35 includes an upper  
part 35a and a rear part 35b connected with each other  
and carries thereon contacts 37 at the lower surface of  
20 an upper part 35a such that each of the contacts 37  
establishes an electrical connection with a  
corresponding contact pad 21 formed on the recording  
head unit 1. In order to assure a reliable electrical  
connection, the cover member 35 is urged in the  
25 direction of an arrow a as indicated in FIG.10 by a

1     spring not illustrated.

          When replacing the ink reservoir unit 2, the user rotates the member 35 about the hinge 34 in the direction represented by another arrow a' against the urging force of the spring and takes out the recording head 100 from the carriage 32. After this, the ink reservoir unit 2 is pulled out in the backward direction with respect to the recording head unit 1 along the guide members 23 and 24 as already described. Next, a new ink reservoir unit 2 is prepared ready for mounting upon the recording head unit 1 by removing the plug or seal of the orifice 25 and further removing the screw or seal 31. The new ink reservoir 2 thus prepared is mounted upon the recording head unit 1 by engaging the guide members 23 and 24 with each other and pushing the unit 2 in the forward direction with respect to the recording head unit 1 along the guide members 23 and 24, until the tubular member 27 is fully inserted into the orifice 25 via the elastic ring 26.

20           The recording head 100 thus assembled is then returned upon the carriage 32 by rotating the cover member 35 in the direction a'. After fitting the projecting part of the base member 3 in the corresponding positioning cutout 36, the cover member 35 is released and the member 35 rotates in the direction a

25

1 as a result of the resilient force exerted by the  
spring. When the cover member 35 is fully rotated, the  
electric connection is established between the contact  
pads 21 and the contacts 37.

5 In the recording head 100 of the present  
invention, the expensive recording head unit 1 is kept  
*and continue to be used*  
~~using~~ while only the ink reservoir unit 2 is discarded  
when the ink is used up. As a result, the running cost  
of the image recording apparatus is reduced  
10 significantly. Further, such a construction of the  
inkjet printer is suitable for saving valuable  
resources. Further, it will be noted that the present  
invention eliminates the need for the complex and  
tedious work of the user to connect the ink reservoir  
15 and the recording head part by one or more tubes. The  
connection between the ink reservoir unit 2 and the  
recording head unit 1 is established automatically by  
simply mounting the ink reservoir unit 2 upon the  
recording head unit 1. Thereby, it should be noted that  
20 the leak of ink at the interconnection part is prevented  
by the use of the elastic ring 26 that experiences  
elastic deformation when the tubular member 27 of the  
recording head unit 1 is inserted into the ink reservoir  
unit 2.

25 Further, by providing the filter 29 on the

1     tubular member 27 in correspondence to the tip end part  
      thereof, one can eliminate the penetration of dusts or  
      particles from the ink reservoir unit 2 into the ink  
      chamber 19 and hence into the head chip 5, and the  
5     problem of the ink passage 16 or the nozzle 20 of the  
      head chip 5 being interrupted by the dusts is  
      eliminated. The vent 30a on the rear lid 30 guarantees  
      the pressure equilibrium between the interior of the  
      reservoir unit 2 and the surrounding atmosphere, and the  
10    supply of the ink from the reservoir unit 2 to the  
      liquid chamber 19 of the recording head unit 1 is  
      maintained even when the amount of ink in the reservoir  
      unit 2 is reduced. As the interior of the ink reservoir  
      unit 2 is sealed by the plug or seal member closing the  
15    orifice 25 as well as by the screw 31 or seal member  
      closing the vent 30a in the state when the ink reservoir  
      unit 2 is shipped by a vendor, the evaporation of the  
      ink in the ink reservoir unit 2 during transportation or  
      storage is effectively eliminated.

20           Another major advantage of the present  
      invention is that the recording head 100 is carried by  
      the carriage 32 with a precise positional alignment  
      thereto as a result of the positioning achieved at the  
      cutout 36 that acts as a positioning means. As the  
25    carriage 32 is mounted upon the recording apparatus 150

1 as schematically indicated in FIG.9, the precision of  
the image recording remains substantially unchanged even  
when the ink reservoir unit 2 is replaced, as the  
position of the recording head 100 with respect to the  
5 recording apparatus 150 is determined by the engagement  
of the recording head unit 1 with the carriage 32 at the  
front part of the base part 3 on which the head chip 5  
is carried. Further, as the electrical contact of the  
recording head 100 is achieved on the recording head  
10 unit 1 of which position is exactly determined with  
respect to the carriage 32, a reliable, failure-free  
electrical connection can be achieved with respect to  
the recording head 100. Further, the use of the porous  
material 22 in the ink reservoir unit 2 eliminates the  
15 problem of cavitation in the ink even when the recording  
head 100 is shaken violently. Thereby, the problem of  
the bubbles formed in the ink reservoir unit 2 blocking  
the ink passage 16 is effectively eliminated, and a  
reliable <sup>recording</sup> ~~recording~~ of images is achieved on a recording  
20 sheet.

Next, a second embodiment of the present  
invention will be described with reference to FIG.11.  
In FIG.11, those parts constructed identically to the  
parts described previously are designated by the same  
25 reference numerals and the description thereof will be

1       omitted.

Referring to FIG.11, an elastic ring 38 having an inner hole 38a is used in place of the elastic ring 36, wherein the elastic ring 38 has a membrane 39 for sealing the orifice 25. In correspondence to the elastic ring 38 thus configured, the tubular member 27 is formed to have a sharpened tip end 40 such that the sharp tip end 40 breaks the membrane 39 when the reservoir 2 is mounted upon the recording head unit 1 as indicated in FIG.12. In correspondence to the sharpened shape of the tip end 40 of the tubular member 27, the recording head of the present embodiment carries a filter 29' in place of the filter 29 in the interior of the liquid chamber 19 in correspondence to the root part of the tubular member 27. According to the construction of the present embodiment, one can eliminate the use of separate plug or seal member for sealing the hole 38a and hence the orifice 25. Further, such a membrane 39 is easily broken by the sharp tip end 40 of the tubular member 27. The construction of the present invention is particularly beneficial to the user of the inkjet printer, as the user can carry out the replacement of the ink reservoir unit 2 without having the stain of ink on the finger.

25       FIGS.13(A) and 13(B) show a third embodiment

1 of the present invention. In the drawings, those parts  
configured identically to the parts described previously  
with reference to preceding drawings are designated by  
the corresponding reference numerals and the description  
5 thereof will be omitted.

In the present embodiment, the ink reservoir  
unit 2 is formed of a plastic and an elongate, needle-  
like projection 41 is provided on a part thereof as  
indicated in FIG.13(A) in correspondence to where the  
10 vent 30a is to be formed. When mounting the ink  
reservoir unit 2, the projection 41 is broken to form  
the vent 30a on the wall of the reservoir 2. It should  
be noted that the vent 30a may be provided on a suitable  
part of the ink reservoir unit 2. Thus, the part of the  
15 ink reservoir unit 2 on which the projection 41 is to be  
formed is not limited to the rear cover lid 30. In such  
a construction, too, one can effectively avoid the  
evaporation of ink in the ink reservoir unit 2 during  
the transportation or storage.

20 It should be noted that the present invention  
is not limited to the recording head of thermal inkjet  
printers as described heretofore with reference to the  
embodiments, but is also useful in other types of inkjet  
printers such as the Gould type printers described in  
25 the United States Patent 3,683,212, of the stem type

1     printers disclosed in the United States Patent  
3,746,120, and the Silonics type printers that employs  
piezoelement for energizing the ink as disclosed in the  
United States Patent 3,946,398.

5             Because the recording head unit used in the  
inkjet printers of these various types of non-thermal  
inkjet printers are generally more expensive as compared  
with the head used in the thermal inkjet printers, one  
may have a more distinct effect of cost reduction when  
10    the recording head of the present invention is used in  
combination with these non-thermal inkjet printers as  
compared with the case of the thermal inkjet printers.

            Further, the thermal inkjet printer to which  
the present invention is applicable is by no means  
15    limited to the type described in the embodiments of the  
present invention wherein the ink is ejected vertically  
to the plane of the substrate of the head chip. For  
example, the recording head of the present invention is  
applicable also to the inkjet printers of the edge-  
20    shooter type that eject the ink droplet generally  
parallel to the surface of the heating element.

            Further, the present invention is not limited  
to the embodiments described heretofore, but various  
variations and modifications may be made without  
25    departing from the scope of the invention.